Patent
0796/66435

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Vjatcheslav Tretiakov et al.
Serial No.	:	Not Yet Known (PCT/IB00/00725)
Filing Date	:	Herewith
For	:	DIGITAL X-RAY SCANNING APPARATUS
Priority Date Claimed	:	June 25, 1999
Group A.U.	:	Not Yet Known
Examiner	:	Not Yet Known

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New York, New York 10036
December 21, 2001

Assistant Commissioner for Patents
Washington, D.C. 20231
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PRELIMINARY AMENDMENT

SIR:

Before examining the subject application, please amend it as follows:

IN THE CLAIMS

Please amend claims 4-7, 9, 10, 12, 14, 16-18, and 20 as follows:

--4. (Amended) The X-ray apparatus (1) according to claim 2, characterized in that a) a housing (10) for receiving the translational and rotational means (11, 13) is provided, which housing (10) can be kept stationary during the scanning movement (8b, 27)

and

b) in particular that the mounting and scanning means (9-12, 7) comprise means (9, 7) for repositioning the housing (10) for different scanning procedures.--

--5. (Amended)The X-ray apparatus (1) according to claim 1, characterized in that

a) means for swiveling (8d) the X-ray source (2) and the collimator (3, 3a) in coordination with the scanning movement (8b, 27) and orienting movement (8c) of the X-ray detector (14) are provided and

b) in particular that a balanced suspension of the X- ray source (2) and the collimator (3, 3a) for a torque-free swiveling movement (8d) is provided.--

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--6. (Amended) The X-ray apparatus (1) according to claim 1, characterized in that

a) a motor drive unit (15) and mechanical coupling means (23) are provided for synchronously driving the scanning movement (8b, 27) and the orienting movement (8c) of the X-ray detector (14) and a translational or swiveling movement (27; 8a, 8d) of the X-ray source (2) or

b) several motor drive units (15) and an electrical control means (2c) for driving and synchronizing the scanning movement (8b, 27) and the orienting movement (8c) of the X-ray detector (14) and a translational or swiveling movement (27; 8a, 8d) of the X-ray source (2) are provided and

c) in particular that sliding clutches are provided between the at least one motor drive unit (15) and moving parts (2, 3, 4, 9, 10) of the X-ray apparatus (1) .--

--7. (Amended) A digital X-ray scanning apparatus (1) according to claim 1, comprising an X-ray source (2), an X-ray collimator (3), an X-ray detector (14), mounting means (9-11) for mounting the X-ray detector (14), scanning means (12, 7) for scanning (8b, 27) the X-ray detector (14) over an area (5), means (16) for digital data acquisition from the X-ray detector (14) and a control unit (2c) for steering the X-ray apparatus (1), wherein additional photographic X-ray imaging means (2, 3, 4) comprising a cassette holder (4) for photographic films are provided, characterized in that

a) the mounting means (9-11) comprise a housing (10) that is designed for receiving the X-ray detector (14) and the cassette holder (4) in such a way that the X-ray detector (14) and the photographic film are facing towards different side faces of the housing (10) and

b) the mounting means (9-11) are designed for performing a reorienting movement (8z) of the housing (10) such that either the film cassette (4) or the X-ray detector (14) is positioned for X-ray imaging.--

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--9. (Amended) The X-ray apparatus (1) according to claim 7, characterized in that

a) the same X-ray source (2) is used for both digital and photographic X-ray imaging and/or

b) the X-ray collimator (3) is removable or a slit (3a) is openable for photographic X-ray imaging and/or

c) the X-ray collimator (3) or the slit (3a) is steered automatically, in particular by a sensor indicating the presence of a photographic film in the cassette holder (4) and/or by a switch in the cassette holder (4) and/or by a sensor indicating an orientation of the housing (10) for either digital or photographic X-ray imaging and/or by a manual switch and/or by

means of software.--

--10. (Amended) A digital X-ray scanning apparatus (1), according to claim 1, comprising an X-ray source (2), an X-ray collimator (3), an X-ray detector (14) , mounting means (9-11) for mounting the X-ray detector (14), scanning means (12, 7) for scanning (8b, 27) the X-ray detector (14) over an area (5) , means (16) for digital data acquisition from the X-ray detector (14) and a control unit (2c) for steering the X-ray apparatus (1) , characterized in that the mounting means (9-11) are designed such that the X-ray detector (14) is held in a position shifted towards an anode side (2a) of the X-ray source (2) by an angle α, wherein $0°<\alpha<\beta$ with β=anode angle.--

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--12. (Amended) The X-ray apparatus (1) according to claim 1, characterized in that the X-ray collimator (3) has an opening (3b) for photographic imaging and comprises at least one movable shutter (19a) with a built-in collimator slit (3a) to provide a precisely collimated beam (26a) for digital X-ray scanning.--

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--14. (Amended) The X-ray apparatus (1) according to claim 1, characterized in that

a) the X-ray detector (14) is a single- or multi-line X-ray detector (14) with X-ray sensitive elements and

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b) in particular that the X-ray sensitive elements comprise scintillator crystals and optical detectors, that are connected to at least one A/D converter and to a microcomputer (16) for serial readout.--

--16. (Amended) The X-ray apparatus (1) according to claim 1, characterized in that

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a) the X-ray detector (14) has a digital signal processor for detector control and data acquisition and/or

b) the X-ray detector (14) has a digital memory for data acquisition and data storage.--

--17. (Amended) The X-ray apparatus (1) according to claim 1, characterized in that for full or partial body digital X-ray imaging distance ranges 900 mm < d_1 < 1450 mm, 500 mm < d_2 < 900 mm and 10 mm < d_3 < 200 mm are provided, where d_1=distance between the X-ray source (2) and the X-ray detector (14) , d_2=distance between the X-ray collimator slit (3a) and the X-ray detector (14) and d_3=distance between the patient (5) and the X-ray detector (14).--

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--18. (Amended) The X-ray apparatus (1) according to claim 1, characterized in that

a) a supporting arm (9) for carrying the X-ray source (2), the X-ray collimator (3) and a housing (10) for the detector (14) is provided and

b) the supporting arm (9) is rotatable and the X-ray source (2) together with the X-ray collimator (3) and the housing (10) for the detector (14) are tiltable with respect to the supporting arm (9) in order to position the X-ray source (2), the X-ray collimator (3) and the detector (14) for X-raying a standing, sitting or lying patient (5).--

--20. (Amended) The X-ray apparatus (1) according to claim 18, characterized in that

a) the supporting arm (9) has a suspension that is movable horizontally (27) for X-raying a lying patient and/or

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b) the supporting arm (9) has a suspension that is movable vertically (27) for X-raying a standing or sitting patient and/or

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c) the supporting arm (9) is rotatable by at least 90° in order to switch between X-raying a standing or sitting and a lying patient (5).--

IN THE ABSTRACT

Please insert an abstract to the enclosed application as follows:

--In order to provide an improved X-ray imaging quality an X-ray detector (14) is equipped with means (13, 15) for orienting it towards an X-ray source (2) during a scan (8a, 8b, 27). Means (9, 10, z) for reorienting a housing (10) comprising the X-ray detector (14) and a conventional cassette holder (4) and detector positioning means (9-12) cooperate to receive an X-ray beam (26a) with improved collimation quality. Thus the detection efficiency is increased, the image resolution is enhanced, and the beam exposure of patients (5) can be minimized. Embodiments relate to a linear X-ray detector (14) designed for a serial readout of image pixels, a collimator (3, 3a, 3b) for both scanning and wide-perture X-ray imaging, and a supporting arm (9) carrying the X-ray source (2), collimator (3) and detector arrangement (17).--

REMARKS

Claims 4-7, 9, 10, 12, 14, 16-18, and 20 have been amended to reduce the filing fee. The abstract inserted herewith is adapted from the abstract in the International application corresponding to the present U.S. application. Favorable action is respectfully requested.

Respectfully submitted,
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Claims 4-7, 9, 12, 14, 16-18, and 20 have been amended as follows:

--4. (Amended) The X-ray apparatus (1) according to [one of the claims 2-3] claim 2, characterized in that

a) a housing (10) for receiving the translational and rotational means (11, 13) is provided, which housing (10) can be kept stationary during the scanning movement (8b, 27) and

b) in particular that the mounting and scanning means (9-12, 7) comprise means (9, 7) for repositioning the housing (10) for different scanning procedures.--

--5. (Amended)The X-ray apparatus (1) according to [one of the previous claims] claim 1, characterized in that

a) means for swiveling (8d) the X-ray source (2) and the collimator (3, 3a) in coordination with the scanning movement (8b, 27) and orienting movement (8c) of the X-ray detector (14) are provided and

b) in particular that a balanced suspension of the X- ray source (2) and the collimator (3, 3a) for a torque-free swiveling movement (8d) is provided.--

--6. (Amended) The X-ray apparatus (1) according to [one of the previous claims] claim 1, characterized in that

a) a motor drive unit (15) and mechanical coupling means (23) are provided for synchronously driving the scanning movement (8b, 27) and the orienting movement (8c) of the X-ray detector (14) and a translational or swiveling movement (27; 8a, 8d) of the X-ray source (2) or

b) several motor drive units (15) and an electrical control means (2c) for driving and synchronizing the scanning movement (8b, 27) and the orienting movement (8c) of the X-ray detector (14) and a translational or swiveling movement (27; 8a, 8d) of the X-ray source (2) are provided and

c) in particular that sliding clutches are provided between the at least one motor drive unit (15) and moving parts (2, 3, 4, 9, 10) of the X-ray apparatus (1) .--

--7. (Amended) A digital X-ray scanning apparatus (1) according to [one of the previous claims] claim 1, comprising an X-ray source (2), an X-ray collimator (3), an X-ray detector (14), mounting means (9-11) for mounting the X-ray detector (14), scanning means (12, 7) for scanning (8b, 27) the X-ray detector (14) over an area (5), means (16) for digital data acquisition from the X-ray detector (14) and a control unit (2c) for steering the X-ray apparatus (1), wherein additional photographic X-ray imaging means (2, 3, 4) comprising a cassette holder (4) for photographic films are provided, characterized in that

a) the mounting means (9-11) comprise a housing (10) that is designed for receiving the X-ray detector (14) and the cassette holder (4) in such a way that the X-ray detector (14) and the photographic film are facing towards different side faces of the housing (10) and

b) the mounting means (9-11) are designed for performing a reorienting movement (8z) of the housing (10) such that either the film cassette (4) or the X-ray detector (14) is positioned for X-ray imaging.--

--9. (Amended) The X-ray apparatus (1) according to [one of the claims 7-8] claim 7, characterized in that

a) the same X-ray source (2) is used for both digital and photographic X-ray imaging and/or

b) the X-ray collimator (3) is removable or a slit (3a) is openable for photographic X-ray imaging and/or

c) the X-ray collimator (3) or the slit (3a) is steered automatically, in particular by a sensor indicating the presence of a photographic film in the cassette holder (4) and/or by a switch in the cassette holder (4) and/or by a sensor indicating an orientation of the housing (10) for either digital or photographic X-ray imaging and/or by a manual switch and/or by means of software.--

--10. (Amended) A digital X-ray scanning apparatus (1), according to [one of the previous claims] claim 1, comprising an X-ray source (2), an X-ray collimator (3), an X-ray detector (14) , mounting means (9-11) for mounting the X-ray detector (14), scanning means (12, 7) for scanning (8b, 27) the X-ray detector (14) over an area (5) , means (16) for digital data acquisition from the X-ray detector (14) and a control unit (2c) for steering the X-ray apparatus (1) , characterized in that the mounting means (9-11) are designed such that the X-ray detector (14) is held in a position shifted towards an anode side (2a) of the X-ray source (2) by an angle α, wherein $0° < \alpha < \beta$ with β=anode angle.--

--12. (Amended) The X-ray apparatus (1) according to [one of the previous claims] claim 1, characterized in that the X-ray collimator (3) has an opening (3b) for photographic imaging and comprises at least one movable shutter (19a) with a built-in collimator slit (3a) to provide a precisely collimated beam (26a) for digital X-ray scanning.--

--14. (Amended) The X-ray apparatus (1) according to [one of the previous claims] claim 1, characterized in that

a) the X-ray detector (14) is a single- or multi-line X-ray detector (14) with X-ray sensitive elements and

b) in particular that the X-ray sensitive elements comprise scintillator crystals and optical detectors, that are connected to at least one A/D converter and to a microcomputer (16) for serial readout.--

--16. (Amended) The X-ray apparatus (1) according to [one of the previous claims] claim 1, characterized in that

a) the X-ray detector (14) has a digital signal processor for detector control and data acquisition and/or

b) the X-ray detector (14) has a digital memory for data acquisition and data storage.--

--17. (Amended) The X-ray apparatus (1) according to [one of the previous claims] claim 1, characterized in that for full or partial body digital X-ray imaging distance ranges $900 \text{ mm} < d_1 < 1450 \text{ mm}$, $500 \text{ mm} < d_2 < 900 \text{ mm}$ and $10 \text{ mm} < d_3 < 200 \text{ mm}$ are provided,

where d_1=distance between the X-ray source (2) and the X-ray detector (14) , d_2=distance between the X-ray collimator slit (3a) and the X-ray detector (14) and d_3=distance between the patient (5) and the X-ray detector (14).--

--18. (Amended) The X-ray apparatus (1) according to [one of the previous claims] claim 1, characterized in that

a) a supporting arm (9) for carrying the X-ray source (2), the X-ray collimator (3) and a housing (10) for the detector (14) is provided and

b) the supporting arm (9) is rotatable and the X-ray source (2) together with the X-ray collimator (3) and the housing (10) for the detector (14) are tiltable with respect to the supporting arm (9) in order to position the X-ray source (2), the X-ray collimator (3) and the detector (14) for X-raying a standing, sitting or lying patient (5).--

--20. (Amended) The X-ray apparatus (1) according to [one of the claims 18-19] claim 18, characterized in that

a) the supporting arm (9) has a suspension that is movable horizontally (27) for X-raying a lying patient and/or

b) the supporting arm (9) has a suspension that is movable vertically (27) for X-raying a standing or sitting patient and/or

c) the supporting arm (9) is rotatable by at least 90° in order to switch between X-raying a standing or sitting and a lying patient (5).--

IN THE ABSTRACT

A new abstract has been inserted.